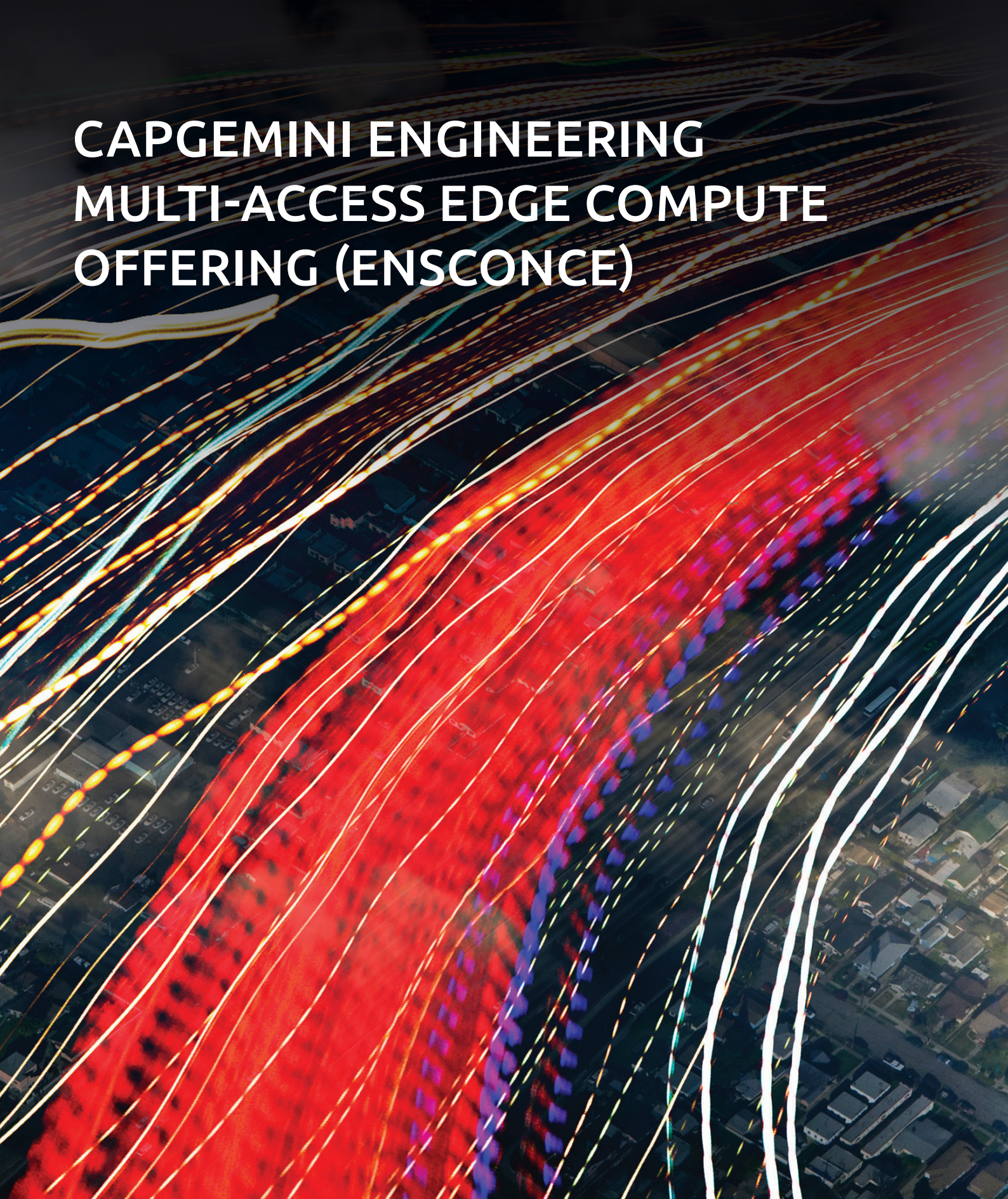


**CAPGEMINI ENGINEERING
MULTI-ACCESS EDGE COMPUTE
OFFERING (ENSCONCE)**

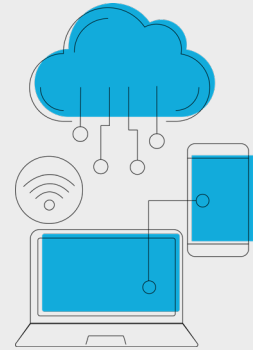


Capgemini Engineering Multi-Access Edge Compute Offering

Multi-Access Edge Computing (MEC) enables data processing and storage at the edge of the network. It supports the development of network applications that process data from network devices – phones, IoT, etc – at the edge, without the need to backhaul it to a distant cloud.

This will enable a next generation of applications that rely on ultra-low latency, high-bandwidth, and access to network information in near-real-time. Such applications may include safety systems based on machine sensor data, systems that coordinate automated vehicles around a warehouse, or crowd monitoring using high resolution video.

MEC therefore creates new opportunities for Communications Service Providers (CSPs) and Network Equipment Providers (NEPs) to develop new applications, leveraging their own networks, unique APIs, and existing real estate. That creates opportunities for new revenue and new business models.



Creates opportunities for new revenue and new business models.



The Capgemini Engineering Vision for Edge Compute

Capgemini Engineering's vision for MEC is to create a developer-centric architecture and cloud-native platform that makes edge discovery, onboarding, and management of applications easy for edge application developers. Our MEC platform provides a comprehensive solution for onboarding applications, which can be integrated into the network architecture. It includes serverless architectures, persistent storage for containers, policy management, simplified orchestration and a microservices-based architecture for MEC services.

Our engagement models are built around licensable software frameworks for the MEC offer, along with professional engineering services. Our solutions help our customers design, build, test and support a telco-grade MEC platform.

Platform Differentiators

- **Innovative multi-edge management mechanism** enabling devices (and developers) to discover the "right" edge while executing applications
- **Innovative distributed and event-based computing architecture** to offload computing from devices to edge through Serverless and Sidecar design patterns
- **Software Development Kit (SDK) for developers** to develop client and edge applications faster
- **Three tier architecture** to enable device, cloud and edge split of the application logic
- **Highly available management system** that manages VNFs/CNFs and Edge Application
- **Automated bootstrapping and commissioning** of micro-data centers
- **Built using open source components** at each layer of the platform architecture

Key Features

- **Innovative mobility management** of edge application context across edge
- **Streaming service between micro-services** i.e. PubSub architecture
- **Edge and edge application monitoring solution** from central hub
- **Integrated identity and access management**
- **Comprehensive edge security management fabric** for edge applications
- **Compliant to GSMA OPG Specifications for EWBI, NBI & UNI Interface**
- **Aligned with ETSI MEC Architecture**
- **Interfaces with 5G NEF** to ensure the security of external applications and provide value-added information to edge applications
- **Accelerated Compute and Storage for MEC** through GPU acceleration
- **Integrated with Intel OpenVINO & OpenNESS**

ENSCONCE: Capgemini Engineering Edge Computing Solution

Enskonce, the Capgemini Engineering edge computing platform, brings together multiple capabilities, software and hardware accelerators, and frameworks to enable rapid development of Multi-Access Edge Compute solutions for CSPs and NEPs. The platform can reside on micro-data centers close to the network, aggregation points, regional data centres, and central offices. The platform enables low latency edge

application development through developer SDK, facilitates provisioning of edge applications on demand, discovery of edge deployments, orchestration of applications across the operator network, mobility of edge application, and monitoring and management of applications throughout its lifecycle. This reduces the barriers for application developers to host their applications at the edge.

Application Onboarding

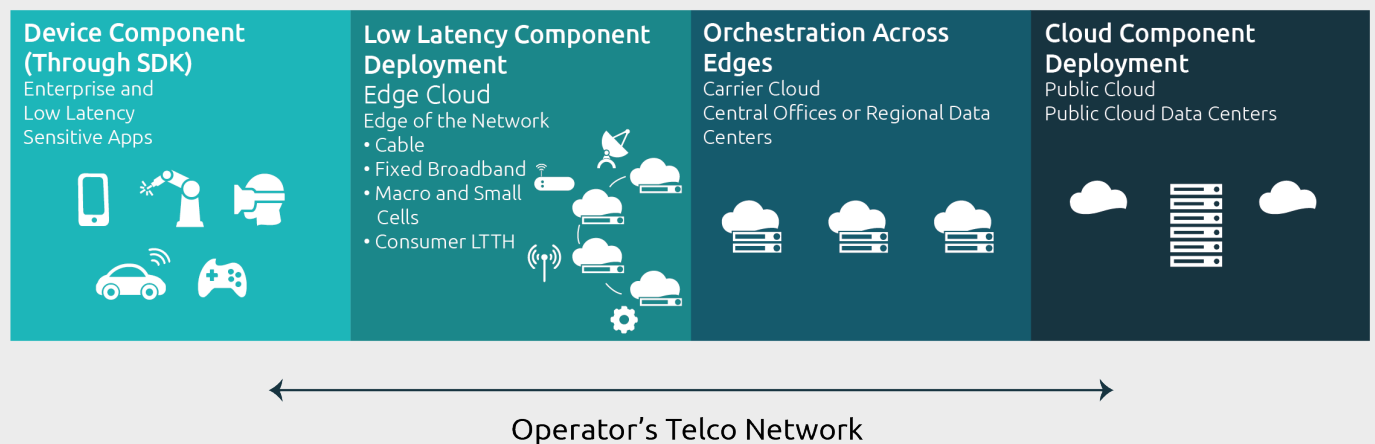
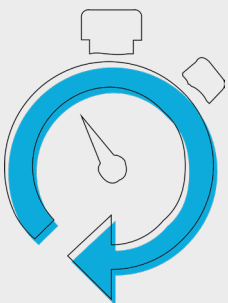


Figure 2: Application Development continuum from public cloud to edge



Enskonce is a feature-rich, cloud-native, distributed MEC platform that helps developers onboard edge applications faster. The key components of the Enskonce platform are:

- Capgemini Engineering Enskonce Central Platform: A comprehensive distributed and hierarchical management and orchestration function for virtualized network functions and cloud native containerized applications
- Capgemini Engineering Enskonce Edge Platform-as-a-service: A comprehensive developer platform to develop, onboard, execute and monitor cloud native applications. Key capabilities include:
 - Serverless and function-as-a-service architecture where developers can offload computing from device to edge or from cloud to edge to leverage low latency computing on-demand
 - Comprehensive DevOps capabilities and automated bootstrapping of complex network, storage and compute aggregation at the edge
 - An SDK that enables application developers to leverage the platform, discover edge at runtime, and optimally use edge storage
 - Ability to run single application instances for each device to optimize resource usage
 - API and event gateways to streamline micro-service-based application access
 - Integrated frameworks of wireless access VNFs/CNFs that can be used to accelerate mobile use cases for edge computing.
 - Pre-integrated with Capgemini Engineering NetAnticipate: A unique capability to drive intent-based networking across the large mesh of MEC nodes distributed across the operator network
 - Access to our knowledge base and proficiency in macros create custom-made tools and apps
 - Ability to leverage IoT technologies and virtual reality in design and visualization



Enskonce is a feature-rich, cloud-native, distributed MEC platform that helps developers onboard edge applications faster.

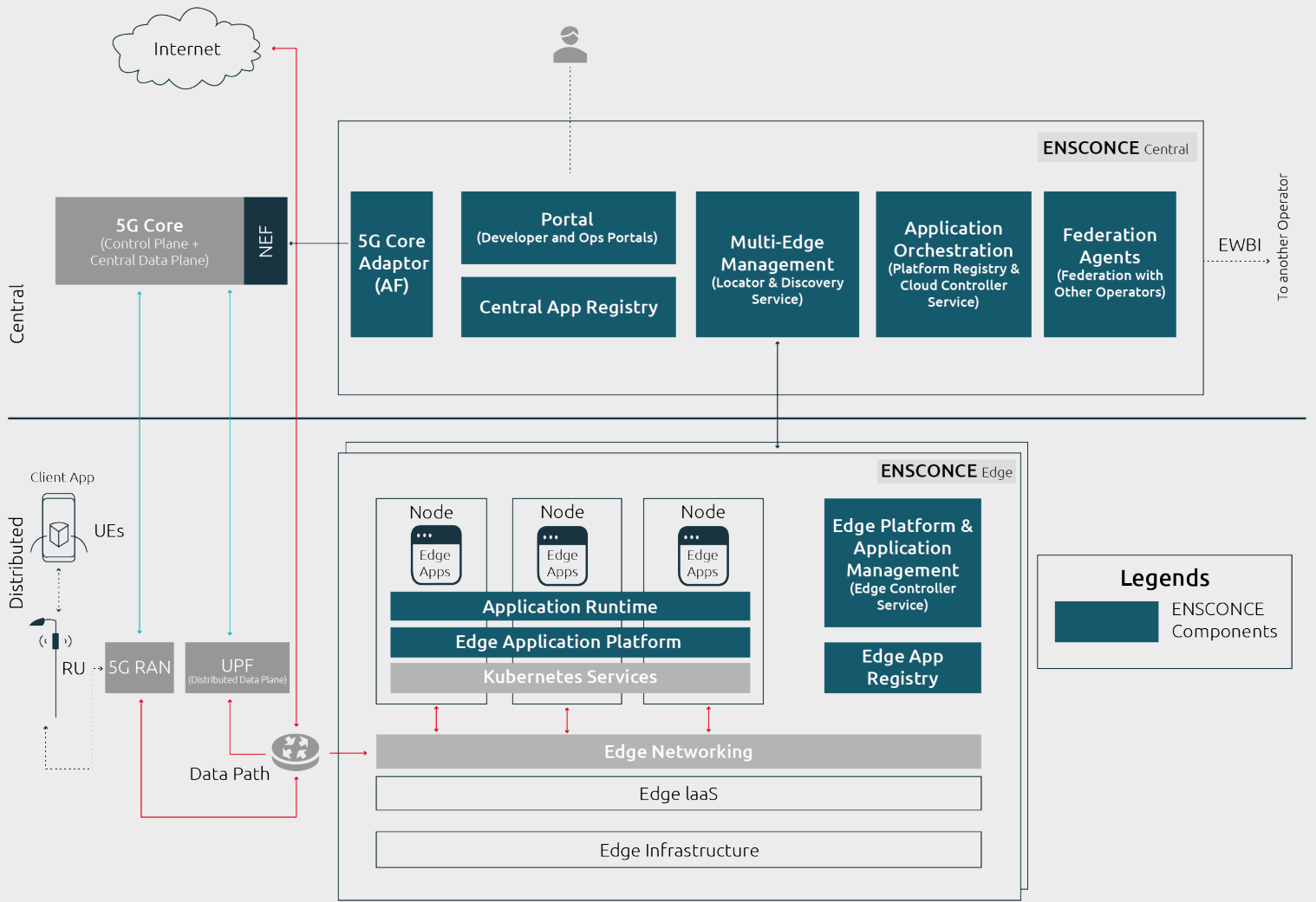




Figure 3: Deployment Architecture for 5G: ENSCONCE service view


Representative Capgemini Engineering Expertise: Cloud to the Edge

Domains






Orchestration and Management






Cognitive Application and Microservice Platform








Networking

Fast Path and SDN Controllers

<p>OpenStack (VM, Container Cluster)</p>  	<p>DC/OS (Bare Metal Container Cluster)</p> 	<p>Kubernetes (Bare Metal Container Cluster)</p>  
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Infrastructure

Installation and Deployment

Figure 4: Representative Altran Expertise and Customer Engagements

Customer Engagement

- Development of large-scale end-to-end edge computing platform solution for a Tier-1 CSP, through developing container clouds at scale including edge compute runtime, central orchestration, mesh networking, developer portal
- Development and research in OpenStack-based low-latency infrastructure platform and split vEPC with a Tier-1 Telecom research labs in North America
- Proof-of-concept on orchestrating split EPC between edge and central office for North American service provider delivering internet and data services at airports and shopping malls
- Development of MEC demo lab for a Tier-1 CSP with platform and integration with 4G access components
 - A cloud-native multi-edge platform and application manager (including NFV platform for virtualized access network functions)
- VNF Manager for VNF management at the edge
- Cloud-based IaaS platform to host cloud-based apps and edge discovery server
- PaaS operational platform for tools, application management and onboarding
- Development of software defined storage for Tier-1 CSP using open source CEPH
- Successful demonstration of MEC Federation between multiple tier-1 CSPs across the globe
- Successful integration with 5G NEF with Tier-1 NEP in 5TONC lab for QoS Customization & mobility state subscription
- Ruggedized complete 5G Enabled Road Side Units for Smart Cities to monitor and manage traffic and connected vehicle use cases
- Built Industrial Edge: co-developing an IoT Edge Platform that can be integrated with the client's digital operations platform

Capgemini Engineering Edge Services: From Concept to Post-Deployment Support

Capgemini Engineering has an end-to-end services model for MEC from conceptualization to post-deployment support. These include digital design services, hardware design, platform development, system integration, testing, and

support and maintenance of the edge platform. Our MEC platform enablers and accelerators, supported by our DevOps approach, allows our customers to quickly move from concept to design to monetization.

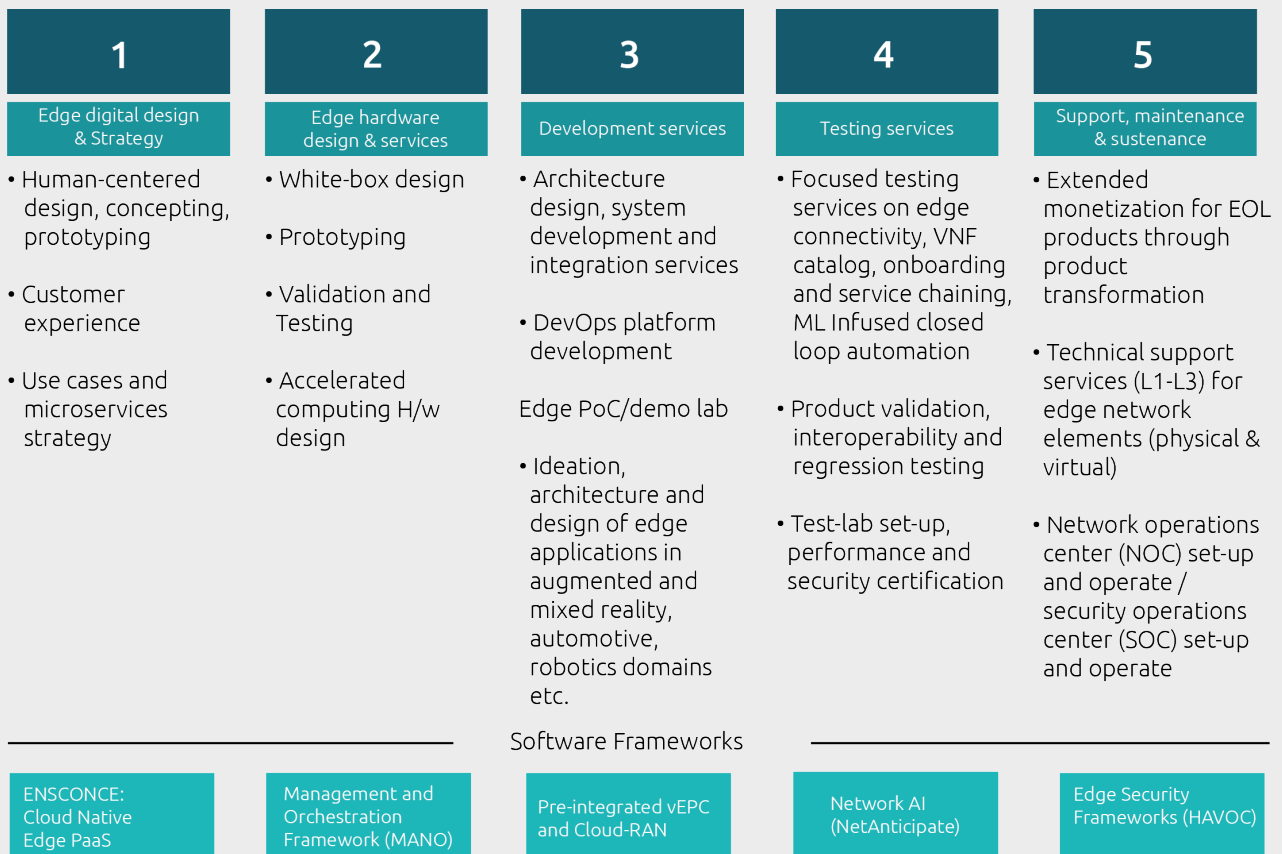
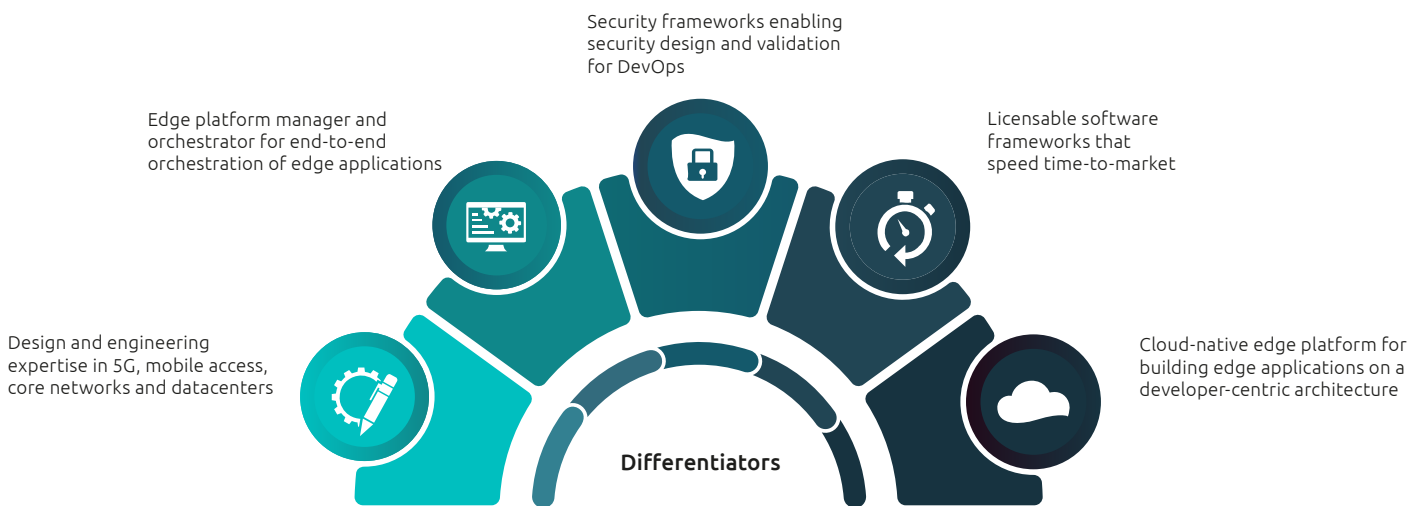


Figure 6: Capgemini Multi-Access Edge Compute (MEC) Platform Enablers and Services

Why Capgemini Engineering?

Capgemini Engineering is a global design, research and engineering services company that supports communications service providers and network equipment providers as they transition from the old appliance hardware model to a virtualized software-enabled ecosystem model that underpins Multi-Access Edge Technology (MEC) technology.



Capgemini Engineering's expertise and experience in the development of service-provider solutions and application-development ecosystems enable our customers to navigate the unique challenges in realizing value from the new technology. Operators should explore and leverage new revenue opportunities from MEC. Capgemini Engineering is actively working with many telecommunications and cable operators around the world on this journey by helping them define their MEC roadmaps, create use cases and establish a path to monetization.

About Capgemini Engineering

World leader in engineering and R&D services, Capgemini Engineering combines its broad industry knowledge and cutting-edge technologies in digital and software to support the convergence of the physical and digital worlds. Coupled with the capabilities of the rest of the Group, it helps clients to accelerate their journey towards Intelligent Industry. Capgemini Engineering has more than 55,000 engineer and scientist team members in over 30 countries across sectors including Aeronautics, Space, Defense, Naval, Automotive, Rail, Infrastructure & Transportation, Energy, Utilities & Chemicals, Life Sciences, Communications, Semiconductor & Electronics, Industrial & Consumer, Software & Internet.

Capgemini Engineering is an integral part of the Capgemini Group, a global leader in partnering with companies to transform and manage their business by harnessing the power of technology. The Group is guided every day by its purpose of unleashing human energy through technology for an inclusive and sustainable future. It is a responsible and diverse organization of over 340,000 team members in more than 50 countries. With its strong 55-year heritage and deep industry expertise, Capgemini is trusted by its clients to address the entire breadth of their business needs, from strategy and design to operations, fueled by the fast evolving and innovative world of cloud, data, AI, connectivity, software, digital engineering and platforms. The Group reported in 2021 global revenues of €18 billion.

For more information please visit:

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